

Introduction to Medical Devices and its Design (IMDD)

Degree: Biomedical Engineering degree at Universitat Pompeu Fabra

Year: 4th year

Trimestre: 1st

Number of ECTS credits: 5 ECTS credits

Lectures: 20h (11 sessions of 2h)

Seminars (all group): 14h (7 sessions of 2h)

Labs (8 different groups of 3-4 people): 9h

Languages of teaching: English and Spanish (E and S, respectively, below)

Coordinators: David Andreu (labs) / Oscar Camara (seminars)

Speakers: There will be seventeen different speakers from industry and clinical institutions.



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Introduction to the subject

The IMDD subject introduces the different aspects of medical devices in different clinical applications, with special emphasis in cardiovascular and neurological pathologies. For each presented technology, most of the following aspects will be treated: basic physiology and pathology of the disease leading to the clinical need for the device; precedent technologies to the device; the specific device, design and materials; insertion and deployment methods; risks and advantages; limitations; examples; indications and use cases; FDA regulations; security in medical devices and implants; optimization of implanted devices; interaction device-tissue.

Lectures and seminars of the IMDD subject will be given by professors involved in medical device research, doctors from large local hospitals and engineers from ten different device companies, including large multi-national enterprises and SMEs. This unique combination of healthcare professionals will provide a complete overview of the medical device sector and may open up career opportunities to the students.

Labs of the IMDD subject will mainly consist in visits to the Arrhythmia Unit at Hospital Clínic de Barcelona to witness clinical interventions with medical devices involved.

Competences to work

The main goal of the IMDD subject is to present the relevant aspects of the medical device pipeline, from having an idea to commercialize a product, in a variety of clinical applications, including cardiovascular and neurology pathologies. The organization of the IMDD subject will put students in direct contact with healthcare professionals working in this sector, improving their knowledge on possible career opportunities.

Topics (lectures and seminars)

Module 1 - Cardiovascular (5 seminars, 2 lectures, 14h)

- A. Radiofrequency Ablation of cardiac arrhythmias. Lecture by **BioSense Webster** (*David Andreu*, E). L1.
- B. Pacemakers, Insertable Loop recorders and Cardiac Resynchronization Therapy Devices. Seminar by **Medtronic** (*María García*, E). S1
- C. Implantable Cardioverter Defibrillators. Seminar by **Boston Scientific** (*Roberto Alanis*, E). S2
- D. Remote monitoring and MRI-compatible devices. Seminar by **Biotronik** (*Josep Asenjo*, S). S3
- E. Advanced sensors in implantable devices. Seminar by **Sorin Group** (*Laia Bayarri*, E). S4
- F. Vascular Devices. Seminar from **Gore Medical** (*Ruben Selfa*, E). S5
- G. Percutaneous Implantation of cardiac valves. Lecture by Dr. *Salvatore Brugaletta* (**Hospital Clínic de Barcelona**, E). L2

Module 2 - Neurology (2 seminars, 3 lectures, 10h)

- A. Neuro-stimulation devices I. Seminar by **Starlab/Neuroelectronics** (*Guillem Mitjà*, E). S6
- B. Neuro-stimulation devices II. Seminar by **Boston Scientific** (*Roger Moreno*, E). S7
- C. Muscle stimulation. Lecture by Prof. *Antoni Ivorra* (**Universitat Pompeu Fabra**, E). L3
- D. Cochlear implants. Lecture by Dr. *Jesús Rodríguez* (**Hospital Sant Joan de Déu de Barcelona**, E). L4
- E. Interventional neuroradiology. Lecture by Dr. *Juan Macho* (**Hospital Clínic de Barcelona**, E). L5

Module 3 - Other applications and environment around devices (10h, 5 lectures)

- A. Abdominal ablation. Lecture by Dr. *Fernando Burdío* (**Hospital del Mar, IMIM**, E). L6
- B. Medical Device Pipeline: From an idea to the patient I. Lecture by **Apeiron Medical** (*Rita Quesada*, E). L7
- C. Medical Device Pipeline: From an idea to the patient II. Lecture by **Ventura Medical Technologies** (*Lourdes Camp*, S). L8
- D. Dental implants. Lecture by Prof. *Francesc Xavier Gil* (**Universitat Politècnica de Catalunya**, E). L9
- E. Industrial design of a medical device. Lecture given by Prof. *Robert Thompson* (**Elisava, Escola Superior de Disseny i Enginyeria de Barcelona**, E). L10

Labs

The lab sessions of the IMDD subject will basically consist in a couple of visits (3h each) to the [Arrhythmia Unit](#) of the Cardiology Department at Hospital Clínic de Barcelona, led by Prof. Lluís Mont (Scale 3, 6th floor).

David Andreu will organize these lab sessions and students will be divided in groups of 3-4 people (around 8 groups). Each group of students will observe clinical interventions mainly for device implantation (pacemakers, ICDs, CRTs) and for radio-frequency ablation of arrhythmias. A report and a presentation summarizing the main points of the visits will be required (see Assessment below).

In addition, there will be a final hands-on session at Hospital Clínic de Barcelona led by David Andreu, with students divided in 2 groups, where the effect of ablation catheters will be studied on an experimental model.

Assessment

- Final exam (40%)
 - Test (yes/no questions) based on the concepts acquired during lectures and seminar sessions
- Reports on seminars (30%, groups of 2-3 people)
 - Chose two companies involved in the subject and prepare a report for each on
 - General information about company
 - Products
 - Pick one device and detail: basic physiology and pathology of the disease leading to the clinical need for the device; precedent technologies to the device; the specific device, design and materials; insertion and deployment methods; risks and advantages; limitations; examples; indications and use cases; FDA regulations; optimization of implanted devices; interaction device-tissue; other aspects.
- Report and presentation on labs (30%)
 - Group report (20%) on visit to Hospital Clínic de Barcelona including: type of intervention during the visit; discussion of the case; type of disease; incidence of disease; type of data used; if any device was used; if imaging systems were used; role of engineer; organization of the Unit of Arrhythmias; discuss on planning of intervention, guidance, follow-up.
 - Presentation on visit to Hospital Clínic de Barcelona (10%). 1st of December, 08h30-10h30.